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The Class Room Teacher[1]

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WHAT I have to say this afternoon is more in continuation of the talk of this morning than might seem from the title. I hope the reasons for making this connection between the two subjects will become apparent as I go on. As I suggested this morning, it is not so much in theory or philosophy of education that we need to provide greater recognition of individuality in the schools, but rather in certain practical considerations. It is easier, more convenient, and cheaper to handle persons in masses and classes than it is to deal with them individually. A very large number of people can learn to run a machine; a comparatively small number of people can be artists of a creative sort. The tendency toward treating students in masses and classes than it is to deal with them individually. comparative ease and comfort there is in working with a smoothly-running machine. In learning the behavior of a machine, how to adjust it, much more is required.

When we come to dealing with living things, especially living characters that vary as human individuals do, and attempt to modify their individual dispositions, develop their individual powers, counteract their individual interests, we have to deal with them in an artistic way, a way which requires sympathy and interest to make all of the needed adjustments to the particular emergencies of the act. The more mechanical a thing is, the more we can manage it; the more vital it is, the more we have to use our observation and interest in order to adjust ourselves properly to it. It is not easy, in other words, to maintain a truly artistic standard, which is, of course, the real business of the teacher; hence the emphasis upon quantity rather than quality.

1 Address given at the State Conference of Normal School Instructors at Bridgewater, Mass., September 5, 1922.

Our whole system of education, with the graded, classified system of inspection and examination, necessitates the handling of large numbers of students at a time, and moving them on according to some time schedule in large groups. These things, rather than philosophy or theory, are the great forces working against a more general recognition of the principle of individuality in education. The whole effect of organized administration sometimes seems to force a kind of standardization which is unfavorable to the development of the teacher's individuality and to the teacher's co-operating in the development of the pupil's individuality.

Wherever there is a mechanical element, wherever we are dealing with physical conditions—space, time, money conditions—there is room, and a necessity, for standardization or uniformity. The danger is, however, that those who become interested in this work of standardizing conditions—the external side of the school work—will forget the limits of standardized uniformity, and attempt to carry it over into the strictly human, spiritual element that cannot be standardized. At bottom, this is very largely a matter of money, like so many other things. But if we ask why it is that the best known and best tested educational ideas are not more widely practised than they actually are, we are quite apt to come up against the fact of professed inability of the community to supply the material means to do the best thing that is possible. I repeat this! Our whole system of examination, inspection, grading, classification, tends almost automatically to introduce a factitious factor that gets between the educator and the human individual that is being developed.

There was an English novel published a few years ago, wherein a young girl, whose parents having died, was brought up in an institution, an orphan asylum. Later on, when someone inquired about her education, she replied, "We never had any education; we were just brought up in batches." That tendency to treat children in batches instead of individually is enforced as a measure of economy.

I was very much interested in what Professor Kirkpatrick said this morning about the subject of intelligence tests. He put the emphasis in the right place, I think. There is some danger in putting the emphasis in the wrong place. I do not

think the leaders in the movement put the emphasis on the wrong place, but I do think there is considerable danger in the mind of the public who have not had a share in the scientific use of the test. There is some danger that the impression should get abroad that when you have a student's intelligence quotient—his I. Q.—you have a certain insight and measurement of him as an individual. If you stop to think what these tests are and what they propose to do, you will see that an intelligence quotient is something quite different from an insight into the make-up of the individual as an individual. It is a method, as the word "quotient" shows, of getting a certain average, in order to show what class of person he belongs, in, a wholly relative matter.

If you take the children of the country at large, you will find a certain number of an average of such and such ability. This particular class belongs in that group having this average intellectual ability. One might say you do not know any more about the individual than you did before. Suppose he has the mental age of 13½, while his physiological age is so and so. He is above or below the average of his age. He is one of certain hundreds of thousands of children in the country who have been tested. We would know so many hundreds of thousands of children attain a mental age of so and so, and that this child belongs in that group. This finding is valuable for purposes of classification, which places the individual where he will work most effectively with others, and prevents useless retardation, of which Dr. Kirkpatrick spoke. It guards against the mistake of trying to make an individual go at a faster pace than he is capable of moving. However, when the teacher has determined this mental level, her work is really just beginning, so far as the psychological interest is concerned.

To turn now to the announced subject for the afternoon. It is the classroom teacher who is in contact with the individuals who are being educated. We might well say that all the rest of the system, organization and administration, is really so much superstructure for enabling the classroom teacher to do his or her work more effectively. It is true that actual education, whatever there is in the way of actual teaching and learning, is done in the classroom, through vital contact, intellectual and moral, between teacher and student.

Like many other things self-evident, we give this basic fact a glance of passing recognition and then do not take it further into account. We emphasize the machinery of administration, the formation and laying out of the course of study, the functions of the school board, functions of the superintendent, principals and supervisors. All these stand in the public eye, at least very often, as the most important elements in the school system. To a certain extent, all these exist for the sake of the ultimate consumers, the teacher and the pupil as they come into direct personal relationship with each other in the school. If these factors of organization, administration and supervision of instruction do not stimulate, assist and reinforce the worker in the classroom, then they are useless, or even worse, since they become encumbrances in the way of the teacher. After all, the truest thing said in education is, "As is the teacher, so is the school." We all know that. The difference between one school and another, between one class in school and another, goes back to the personality of the principal or teacher. The problem is then: How are we going to concentrate all of these more external elements so that they really will emancipate, assist and safeguard the individual teacher in the classroom? Have we not, to some extent, been looking through the wrong end of the telescope Do we not need to look more frequently through the end that magnifies the work of the classroom teacher and places that work in a better position?

Referring briefly to the course of study. I would have the best experts in the country studying the proper course of study. I would have experts in history, geography, arithmetic, and other subjects in the curriculum. Let them meet together and discuss what is the best subject matter out of the vast range of subject matter to be had. That may be, and should be, of great assistance to the classroom teacher, but it does not wholly determine what the actual subject matter is that comes home to the pupil. The course of study should be a *course;* it ought to be a flowing, moving thing, for its subject matter comes into continuous contact with the minds of the pupils.

There is no way by which subject matter, as laid out by experts, can get over to the pupils, except through the medium of the teacher. We can have a text-book written in accordance

with the recommendation of experts. But after all, will not the last thing that counts be how the teacher uses that text-book; how it is handled; the questions that are asked? You can have very rich, full subject matter laid down on paper, and yet the personality and intelligence of the teacher may be such that the subject mater will shrink, dry up, and become a mere trickle of dull fact when it gets to the pupil. You can have an outline of a course of study, in the form of a bare skeleton on paper, and yet that course of study, as it gets over to the pupils in the classroom, may be very full, rich and alive, because of the spirit that the teacher puts into it; the methods the teacher uses; the assignment of outside study that the teacher gives, and new points of view in the student mind. What is true here of the course of study, as it comes to the pupils through the teacher's mind and personality, is true, in my judgment, of many other things in the educational system. It is the failure to concentrate all of the various school resources upon the power of the teacher that is a fundamental cause of some stereotyped mechanizing of our educational system. I repeat. Because the classroom teacher stands for this element of personal individual contact, while administration and organization are influences which are modified as they reach the pupil through the teacher, the central problem is how to use all of our existing resources in developing the classroom teacher.

We all know that there is a very great gap between our theories and our practices. Many of the wisest and truest things about education have been said for many hundreds of years—some of them by Plato, over 2,000 years ago; others, in the educational reforms of the last three or four hundred years. Many have come through discoveries in recent years and in our own day. But we all know that, even if these discoveries had not been made, there was enough known before as true and wise by educational experts immensely to improve our schools, indeed to have revolutionized them. I remember a few years ago a young woman who, for some reason, had escaped a secondary school education, for better or worse, and decided she wished to be a teacher. She went to Teachers College to study all of the improved theories of teaching. She later took a place in a school, and she had a surprise, not to say shock,

which most of us who have come through an educational system would not have. Here were those things taught by the authorities, agreed to by the authorities as true, as well as modern and up-to-date, and she assumed she was going to find schools run on the basis of these advanced theories of which she had learned. It was the discrepancy between the teaching she had and the actual practice and teaching in the schools that gave her this shock. It brought home to me how wide this gap is, after all, and how the crucial problem of the improvement of education is to make those advances that we have in theory and administration, effective upon the work of the teacher, so that they will seriously affect the life of the pupil.

A teacher, a short time ago, at the suggestion of another teacher, made a study over a number of years of the volumes of reports of the N. E. A., with a view to seeing who was making the vital contributions to educational thought; contributions that were supposed to influence practice. As perhaps you will guess, a very small percentage of the papers read at the N. E. A., the addresses made, came from classroom teachers. If we eliminate the number coming from high school classroom teachers, the number coming from elementary classroom teachers was negligible. I doubt if it was one per cent, going over a series of years. That seems to me to be a deplorable fact. It indicates that, for some reason, classroom teachers are not being the active force in the improvement of educational practice that they should be. The people who are doing the actual work of instruction, that are in personal contact, are personal influences on the character and minds of the students, are not the ones who are actively carrying forward the theory. I realize how many explanations can be given for this condition,—such as lack of time, teachers overburdened with work, etc. The university or normal school teacher or principal may have more leisure to study these things, but, after all, since it is the teachers who make the final application, ought they not to play a large part in developing and making concrete and real the ideas which they are engaged in executing?

In industry and factory life we have a sharp separation between those who plan and those who execute. I wonder, however, from the standpoint of the welfare of the country, whether, even in a factory, it is advisable to have so sharp a

line of division between those who plan and those who execute. But certainly, when we come to such a vital thing as education, it is still more dangerous to have this sharp distinction between those who plan and those who do the work of execution. The result is that the teacher, who does not have part in developing ideas, cannot have that sympathetic understanding of them that one has who has taken part in working them out. The principle of learning by experience, if it is a good principle for pupils, is a good principle for teachers. If our ideas and theories ought to be arrived at inductively, if they ought to grow up out of actual experience, why should not the concrete experience of the classroom teacher develop more in the way of educational ideas and principles than it does at present? I think one reason for the gap between our modern theories and what is known and accepted in school practice, is largely due to the fact that the intellectual responsibility of the classroom teacher has not been sufficiently recognized or magnified. You know, if you are engaged in carrying out plans and ideas of one person, you do not, and cannot, throw yourself into it with the same enthusiasm and wholeheartedness, or same desire to learn and improve, that you do when you are carrying out plans and ideas which you yourself have had some share in developing.

The function of the supervisor is important and valuable. Obviously, it should be one of inspiration and of education, rather than that of simply writing prescriptions such as those the doctor writes, and which are then handed to a drug-store clerk to fill out. Teachers should not be clerks filling out recipes that are prescribed by others. They should not be like cooks in the kitchen, who take a cook-book and mix ingredients in the proportion called for by the recipe in the book, not knowing why they do this or that, or with any expectation that they are going to make any discoveries or improvement. The real cook is the one who originates all the improved dishes that we like to eat. And the permanent improvements in the course of study must be those which are either contributed to, tested by, worked out, experimented upon intelligently by the teacher in the classroom.

A good deal of supervision, so-called, especially when class supervision is the watchword of the day, seems to have a great

deal of "super" in it and not much of "vision." It is the business of the supervisor to look over the field, to get a larger, wider, more thorough view of it than the conditions of the classroom teacher can permit. It is the privilege of the supervisor and directing officer to give the classroom teacher the benefit of this larger, more comprehensive vision of the field.

There are, of course, some valuable short cuts and mechanical devices. It is difficult always to be a creative artist. I think, however, that we should get on more rapidly if we realized that, if education is going to live up to its profession, it must be seen as a work of art which requires the same qualities of personal enthusiasm and imagination as are required by the musician, painter or artist. Each one of these artists needs a technique which is more or less mechanical, but in the degree to which he loses his personal vision to become subordinate to the more formal rules of the technique he falls below the level and grade of the artist. He becomes reduced again to the level of the artisan who follows the blue prints, drawings, and plans that are made by other people.

I think what first interested me in this problem of the greater freedom on the part of the teacher, was carried or transferred from an interest in more varied and creative, independent and original work on the part of the pupil. Finally, I saw how inconsistent it was to expect this greater amount of creative, independent work from the student when the teachers were still unemancipated; when the teachers were still shackled by too many rules and prescriptions and too much of a desire for uniformity of method and subject matter.

As Mr. Baldwin said this morning, every course of study put in print is more or less out of date by the time it is in print. It can serve only as a suggestion for the teacher, and every classroom teacher ought to be regarded by others, and regard himself or herself, as responsible not only for the teaching of recognized subject matter, but for the making of new contributions to subject matter. Think of the variety of the universe we live in, the history of society and human life! There is no end to the riches of the material that it is possible to draw upon. We can only begin to attack the reservoir of subject matter in education. There is not a teacher fit for the work, who is really stimulated to do her best, who will

not find in her own locality, suggested by the needs of the locality, or stimulated or aroused by the questions that pupils ask, some new field of subject matter which will satisfy the mental hunger of the pupils at the present time. We shall not make our theoretical improvements in education practically effective, we shall not realize upon them and get them over into concrete cash values, until we expect, as well as give, opportunity where every individual pupil can exercise freedom and discuss certain lines of subject matter in the school in contact with the teacher, quite irrespective of any formula or prescribed course of study.

The imagination of everybody today, their unconscious way of seeing things, is more influenced by industrial considerations than we realize. The way business is done influences unconsciously all our ideas. So we have from business practices carried over into education too much standardization, too much concentration of responsibility. There should be concentration of responsibility, but if, in a school system, you concentrate responsibility in a small number of people, what does that mean for the rest of the people? Is it not a division of irresponsibility, when you have concentrated your responsibility in a few? Responsibility needs to be concentrated, but in everybody. Every part of the school system needs to have responsibility for improvements in subject matter, in methods of instruction, in methods of discipline. When we try to place all responsibility on a few administrative officers, we are practically depriving the greater number of teachers of responsibility. That is why I say that concentration of responsibility is a division of irresponsibility. Too often the relation between pupils and teachers is reduplicated in the relation between teachers and supervisory officers. Pupils, many of them, strive to come up to the external standards that are set by the teacher, and the main question with them is whether they can get by; whether they can do enough at the proper time to satisfy the demands and expectation of the teacher. This situation is often reduplicated in the relation between teacher and the supervisory officer. The teacher is simply concerned with the things that will meet external standards that are set for her.

My attention was first called to this by one of the finest women I ever knew, Mrs. Ella Flagg Young of Chicago. Mrs.

Young began as a classroom teacher, and became a supervisor, an associate superintendent, and finally, superintendent. From forty years' experience she knew from every angle the public schools of a large city. She saw the schools from the standpoint of the teacher and supervisory officer, and was acutely aware of the situation that could exist in a highly organized school system between two parts of the system.

The classroom teacher has this advantage. She is on the job all the time. There are not enough supervisory officers to go around and be on the job all the time. They can only visit now and then. But under a regime of class supervision, the teachers often develop a very great skill in doing what they like to do, and at the same time appearing to be carrying out the directions of supervisors. The advantage is on the side of the classroom teacher, because she is there all the time.

Let me repeat a story told by a teacher: "As a high school teacher in algebra I had what I thought was an unusually successful recitation, because the pupils were doing all the work. I was acting as umpire. The principal came in and did not see me doing anything. He reproved me afterwards, and said that I was lazy. I remedied that immediately. Every time he came into the room after that, I began to lecture to the pupils, and he thought I was a good teacher. Personally I do not think I was teaching so successfully."

I sometimes think the greatest human loss there is at the present time is in the loss of experience as to our human contacts with each other. Parents too often start out having to take and train their own children as if nobody had ever done it before. There is some improvement now, but, after all, how much experience goes unrecorded and unutilized that might be rendered available for others. And so in the school, because the teacher is not given a responsible position, how much in the way of experience there is that goes unused, that does not become food for their further teaching, and, because of that, other people, perhaps professors like myself in universities, who are more or less at arm's length from the situation, have to provide ideas and theories that are more or less abstract. These ideas and theories do not get translated over into vital results because the teacher has not had share enough in building them up and contributing to them.

Vitalizing the Problems of Good Citizenship by Means of the General Science Course

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A CENTURY ago the bulk of the people of the United States were farmers. The family group was quite independent and carried on a comparatively isolated existence. The labors within the family group or organized household were sufficient to meet the needs and wants which were concerned with food and clothing. The farmers raised sheep and sheared them, carded and spun and wove their own woolens. They raised flax and from it made linens. Beef and pork, poultry and dairy products, and vegetables and fruits sprang directly from the united labors of the family unit. Firewood and building materials were in abundance and near at hand. The home-made candle provided sufficient artificial light for these people, among whom it was the rule of life to rise with the daylight and to go to bed when it was dark. For a share of the grain the neighboring miller ground the wheat and corn to flour and meal. Teas and silks and similar luxuries were obtained by direct exchange for whatever products the farmer had in excess of his family needs. The village blacksmith, the doctor, the pastor and the schoolmaster were paid in part with products that resulted from the handiwork of the several families among whom they labored. In short, those early families had everything they needed except money, and they had little need for that. What money there was, was hard to get, and it was always reserved for the payment of taxes. Consequently, the government and its few and limited agencies were at this time regarded as outside affairs, of which the less the people heard the better. While the government was popular in form, it was wholly apart from the immediate needs and interests of the family.

The children of this early period found themselves in a social situation that was easily comprehensible. Indeed, the greater portion of the children were not mere observers in the affairs of life, but were active participants in the many pursuits

that related to their and their families' welfare. They aided in caring for the herds, turning the soil, planting the grains, gathering the harvests, and preparing the raw materials for food and shelter. The problems of the family and each of its members were the concern of all—young and old. Heavy toil rested on human hands, and human life was of necessity simple. To live amidst such conditions was to practice self-denial and strict economy, which developed the power of self-restraint and the habit of thrift,—the remarkable traits of our immediate forefathers.

When invention harnessed steam with steel and brought into existence the many labor-saving devices, humanity stood on a new threshold. Man's wants increased, and the primitive methods of farming gave way to new methods in which labor-saving machines made it possible to bring into existence greater supplies of raw materials for food and clothing. Today the improvement is such as to allow five men with modern farm machinery to do the labor of one hundred European peasants without machinery. Consequently, those who are not needed on the farm find their way to the cities, and are employed in the manufacture of finished products from the raw materials of the farm and mine.

Moreover, the American agricultural colleges have taken up the question of crop improvement and soil conservation, to the end that farm yields are ever on the increase for the amount of labor so employed. Added to this has been the constant opening up of new and fertile regions, which have more than made good the losses of the old and exhaused soils of older regions.

Furthermore, the building of railroads and telegraph lines made possible the sale of foods and their transportation from distant farms to the markets of the ever-growing city. The advantages of rapid transportation, with its huge capacity for carrying raw materials from distant points, grouped vast manufacturing industries in and about cities. As such enterprises grew, greater numbers of workingmen from farms and foreign countries took up their residence about the industrial centers. While these causes and conditions are the main factors that contributed to the great growth of our densely populated centers, many others were in operation and served to guide the human stream in one direction,—toward the American city.

The facts point out that the nineteenth century gave us the conditions that brought our present-day city into existence. While those living in the nineteenth century gave us the large city, they were quite unable to give it to us with its many problems solved and in good working order. The problems of the great city are for us of the twentieth century. We must become fitted and trained in the art of city building and city improvement, if we wish to succeed as a people—as a nation. The large city and its continuous growth constitutes the greatest of all problems of modern civilization.

From colonial times to the present there has always been a strong tendency in America for cities, towns and counties to govern themselves. Consequently, when we read the ordinances put into effect by the Select Councils of our early American villages, we are able to get a clear picture of their attempts toward the supervision and the control of those things used in common and toward the maintenance of public health and safety. Indeed, these efforts on the part of our forefathers in behalf of a more wholesome village household, furnish us with striking examples for the teaching of lessons in modern municipal housekeeping. For example, during the years 1802-1814 the Select Council for the Village of Cincinnati adopted the following ordinances:

1. To organize a night watch of all male citizens over twenty-one years of age, to be divided into twenty classes who shall patrol the city at night.
2. To compel citizens to remove logs and other debris from the roads.
3. To establish a market and see that goods are sold at full weight.
4. To provide that chimneys shall be built of stone or brick.
5. To elevate, grade, and pave the sidewalks.
6. To tax all theatrical and puppet shows.
7. To prevent chickens from trespassing, and pigs from running at large.
8. To prevent the spread of smallpox through segregation and vaccination.
9. To compel property owners to fill up places where stagnant water stands in pools.
10. To secure a quiet Sabbath.

Each of these ordinances presents subject-matter of the richest sort and worthy of the most serious study on the part of classes in history, civics, biology, and general science. For an examination of the ordinances shows that the greater number of them are concerned with problems dealing with the

security and the safety of life and property and with questions of community health. The Select Councils of these early villages were forced to make rules and regulations, because some of their inhabitants endangered the welfare of the community. Some dealt in short weights and practiced dishonesty. Some trespassed, or worse, allowed their animals to trespass. Some had pools of stagnant water which were objectionable for many reasons. Some allowed filth to accumulate in roads over which they and others had to travel. Other broadcasted the germs of disease, and thus endangered the health of all. Some of these offenders were ignorant and knew no better. Others were willful and selfish and had no thought of community welfare. Still others were deliberately opposed to a community organization of any kind, and were unwilling to co-operate in the safeguarding and upbuilding of the community interests. The picture of the community life in the early village displays to us in a forcible way the two kinds of citizens that composed its populace,—the destructive and the constructive. The picture is, indeed, simple; its portrayal of the opposing forces is clear; we understand the situation, and we regret the presence of a destructive opposition of ignorance, willfulness, selfishness and deliberate unwillingness to co-operate in securing that which is right and well.

It is much the same in our great and overgrown cities of today. There are still great groups of people who are ignorant of the real purpose of the community in which they live; they have no community ideals, and having no ideals, they have no community interests. They lie, cheat, steal, burn, kill, destroy, intrigue, corrupt, pollute, waste, and broadcast disease. They are destructively employed. They contribute nothing to the co-operative efforts that strive for improvement. Nor is that all. The necessity for dealing with such people withdraws a considerable portion of the best laboring forces of the community into protective agencies of various sorts. We have policemen, constables, magistrates, jail keepers, food inspectors, censors, and detectives—public and private. These protectors are just as necessary today as they were in the pioneer village of earlier days. It seems unfortunate that so much protection and detection of every sort is essential for the maintenance of social order in our great community households.

The troubles of the modern American city, and of the state and nation as well, rise from one particular source: the idea that we can legislate our evils out of existence rather than dissolve these evils through training and education. So long as we continue to stem selfish impulses of humanity through the channels of legislation and the enforcement of legislation, just so long will these same impulses continue their evil opposition to that which is right and best for social existence. For the legislation of laws and the enforcement of laws can never give to the ignorant the fruits of learning, nor to the indolent the compensations of industry, nor to the indifferent the rewards of ambition, nor to the depraved the merits of virtue. The utmost that any government can do is to protect men, not against the wrong that they do unto themselves, but—and only in small measure—against the wrong that is done unto them by others.

For a century and a half our nation has existed under a form of popular self-government. At first its functions were necessarily few and simple. Today its offices are many and varied. Throughout this period of development and transition, our press, our public orators, and our schoolmasters have defined *popular self-government as organized self-control,—the organized capacity of all for the development of all.* While this definition of popular government seems ideal, we must not delude ourselves with the notion that such an ideal of human existence and interrelationship has yet been accomplished. For it is under a popular form of government that we find the selfish and the cruel passions in serious conflict with the good and noble impulses that seek to establish honesty and virtue—public purity—in social order. It is these tremendous forces for good or evil that express themselves in laws, in the enforcement of laws, in contempt for laws, in good administration and in bad administration. When popular self-government is good, security, success, contentment and development come according to the capacity and the courage of those who respect the government which they themselves have created; when this respect is wanting, government is bad and disaster comes to all. Under good government, industry and comfort flourish, even though the soil be quite sterile and the climate rigorous. On account of bad government some of the fairest

and most fertile spots of the earth have become wildernesses, or habitations of squalor and wretchedness.

The fulfillment of the purposes of a popular government—the permanence of modern civilization—can never be accomplished except by a process of evolution through education and practice, in which the great masses of humanity acquire self-restraint, soberness of judgment, and loyalty to the fundamental principles that are so essential to stable and effective government. The philosophy of morals, the teachings of history, in short, the whole experience of the human family, points to but one conclusion,—that in the conduct of life the most difficult and the most essential virtue is that of self-restraint. It is the first lesson of infancy; it is the characteristic for which kings and captains are most highly lauded; those who have it not are shunned and feared; it is needed most where power is greatest; and it is needed more by men acting in masses than by individuals, because men in masses are more irresponsible and difficult of control than individuals. Consequently, the success of our present-day democracy is dependent upon the degree of advancement that is made in social education,—a type of education that has to do with the responsibility of associated living.

The question of the hour is how we shall educate for intelligent participation in a social democracy. The principles of modern psychology point the way. If we are to prepare the child of today for serviceability on the morrow, we must make use of those experiences of the child that bear on the characteristics which we wish to develop. The social experiences of the child of the past century were on the whole simple and easily comprehensible. The social experiences of the child of today are greatly complicated and difficult of comprehension. A century ago the arts of life lay fully revealed; there was no mystery in the relationship of wheat fields to the loaves of bread, or that of the black sheep to the little boy up in the lane. The entire industrial process stood disclosed, and the whole of the social situation was meaningful. The home of today provides no such opportunity for experiencing a round of activities that have to do with the arts of life. The immediate community in which the child is born and reared provides a social existence that is essentially meaningless. So much a matter

of routine is every movement, so timed is every act of life, so intricately interrelated are the arts of life in the organized whole of life—the community—which the child finds about himself, that he accepts as natural that which is wholly artificial. So real is the seeming naturalness of it all, that he conceives life to be one of individual independence, rather than one of social interdependence. These misconceptions are carried, not only throughout childhood and youth, but often throughout life. Such misconceptions handicap not merely the individual who believes and practices them, but the great social unit in which he takes his place. The misconceptions acquired in youth are the source of much of our present-day spirit of selfish intolerance, which makes impossible the perfection of associated living. The acquirement of false conceptions of community life on the part of the youth is directly chargeable to society itself, for the reason that it fails to provide and to equip its growing youth with such experience as will give a clear vision of worthy ideals in social living and social improvement.

It is essential, then, that the many institutional groups that make up society, busy themselves and reveal to its youth the relationship of things as they are. The fundamental institutional groups of the community are the family, the school, and the church. While each of these labors permanently for some common purpose peculiar to itself, it is from these that come the great moral forces that run through the community organization and weld it into a common whole. Much could be said about the importance of each of these great institutions and the dependence of the community upon the success of each. Of these institutions the family is the essential one, and since its communal existence demands that it live in combination and organization with other families that are equally dependent, it is essential to set up community standards of conduct regarding domestic relationship. Such a domestic relationship gathers the whole of the community into one big household, in which it is necessary to do collective housekeeping in order to preserve in good order those things which the people use in common. That is, the community household is concerned with problems that have to do with supplies of wholesome water, sanitation, food inspection, clean air, protection against infec-

tious diseases, and with many others relating to community welfare. The solution of community problems depends directly upon the interest of the many individuals of the community. If individual citizens are not interested in wholesome drinking water, it is not likely that the community will be provided with good water. A clean city is very likely to be a relatively healthful community. But city cleanliness consists of cleanliness of shop and factory, and cleanliness of alleys and streets in the neighborhood of the home, shop and factory. But individuals who are not acquainted with the importance of wholesome water, pure air and sanitation, are apt to hinder and oppose these undertakings so essential to the welfare and happiness of the community. In order, then, to quicken the public spirit, to stimulate a stronger desire for co-operation, and to bring about a feeling of greater responsibility on the part of the developing youth, it is fundamental that our educational systems take a more active part and portion in preparing the youth of the present for a greater and truer citizenship in the future. For it is only as new life comes into society that opportunity arises to improve the character of life.

When we examine the curricula of our elementary and secondary systems of education, we find that the old dualism which would classify subjects as cultural or non-cultural, as humanistic or scientific, as esthetic or materialistic, is rapidly dying out. All subjects are cultural in the degree to which they develop wider appreciation of that which is worthy in life. When properly conducted and interpreted, study in any of the courses in science develops an appreciation of the inner meanings and connections of things, an appreciation of the service of science to the life and civilization of our time, an appreciation of the slow, painstaking efforts and tremendous toil with which scientific progress has been accomplished, and an appreciation of the privileges, duties and responsibilities that living in this age of science involves. It is a serious indictment of science-teaching to charge that it overlooks any of these fundamental relationships. Furthermore, the sciences touch upon the efficiency of life in the home and the community at every angle. General science, biology, physiology, physics, chemistry, all have definite services to render toward the proper organization, use and support of life in associated living. The

sum total of all instruction in general science should aim at the realization of the six objectives of right living,—health, worthy home membership, vocation, citizenship, the worthy use of leisure, and an ethical character. In order to secure the accomplishment of these aims and ends, courses in general science find their place in the curricula of our schools, not as substitutes for any one or more of the special sciences, but as a basis for the discovery of interest in the science of right living. They enlarge vocational opportunity and prove to be the best training for those pupils who can take only one science course. To accomplish their purpose, they find their subject matter in the environment of the home and the community; they deal with the forces and materials in nature and their adjustment to the comforts of man, with the conditions of life and growth, and with means for their improvement.

The Training of Science Teachers in Subject Matter

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THE problem of training science teachers may be clarified by an examination of the field for which training is desired. The need for attention to this problem is evident, for significant changes in the kind and amount of natural science offered in secondary schools have not been accompanied by corresponding changes in the program of teacher-training. This article attempts to define the field, and it reports a brief examination of the training which students are offering for work in this field. The definition of the field in a particular state is made in terms of: (1) number of schools in that state offering, and the enrollment in each of the sciences offered, at a given period; (2) the trend of the offering and enrollment over a period of years; (3) recommendation by the State Department of Education of science subjects to be offered; (4) the content of general science; and (5) the teaching programs of science teachers in service. Some notion of the training which students are offering as preparation for service in the field, was obtained from an examination of the records in the registrar's office of students who had graduated from the State Univer-

sity, and who have received recommendations to teach some natural science. While the conditions reported in this article represent Minnesota in particular, the situation revealed is no doubt fairly illustrative of what might be found in any state.

Some articles have already appeared which report studies of the general field of high school teacher training.[1] A very illuminating article dealing with the special field of natural science has recently appeared.[2] The present article presents data which supplement those already available, and in addition it attempts to formulate a program for training teachers of science, which will in some measure meet the needs of students preparing to enter this service.

The field of science teaching in Minnesota is in part defined by the report of the high school visitor.[3] His report shows the number of schools offering and the number of students enrolled in each of the divisions of high school science. Table I presents this information for the school year of 1919-1920. Table II presents for comparison enrollment figures from four other states.[4]

TABLE I.

Number of high schools offering and number of students taking each of the sciences.

	Schools offering	Students taking
Physiology	121	3082
Physiography	91	2092
Botany	112	3072
Biology (General)	21	889
Zoology	66	1450
Physics	158	3835
Chemistry	169	4790
Geology	1	11
Astronomy	0	0
General Science	121	5684

1 Koos, L. V. and Woody, Clifford. The training of teachers in the accredited high schools of the State of Washington. The Eighteenth Year Book of the National Society for the Study of Education (1919), pp. 213-257.

2 Huston, P. W. High School Science Teachers: A Study of Their Training in Relation to the Subjects They are Teaching. Educational Administration and Supervision. 9:423-438. (October, 1923.)

3 Twenty-seventh Annual Report of the Inspector of Minnesota High Schools for the Year Ending June 30, 1920, p. 41.

4 From data reported by Caldwell, Otis W. Preparation of the General Science Teacher. School Science and Mathematics, 23, 307-313 (Apr. 1923).

TABLE II.

Number of students taking high school science in four states.

	New York (1921)	Pennsylvania (1920)	Connecticut (1921)	Washington (1921-22)
General Science	10,037	28,117	4,226	7,802
Biology	50,658	13,903	2,263	1,604
Zoology	323	4,131	130	1,061
Geology	0	68	191	54
Physical Geography	4,601	11,772	.....	1,322
Chemistry	18,169	10,642	1,913	3,288
Physics	16,047	13,188	2,061	4,200
Advanced Biology	2,254	.....	.....	.....
Physiology and Hygiene	42,922	.....	117	994
Botany	948	4,682	405	2,673
Applied Chemistry	2,946	.....	.....	.....

From these tabulations it appears that the largest demands are in order in Minnesota for teachers of chemistry, physics, physiology, general science, and botany. There is considerable offering of physiography and of zoology.

Figures on the enrollment in subjects on different years contribute materially in defining the need for teacher-training in different fields. Such figures are presented in Table III.[5]

TABLE III.

Enrollment by subjects for different years.

	1914-15	1918-19	1919-20
Physiography	3264	2895	2092
Botany	3981	3196	3072
Zoology	2275	1570	1450
Physiology	3095	3058	3082
Physics	3865	3371	3835
Chemistry	4293	4505	4790
General Science	485	4652	5684
Biology	no data	779	889

The increase in enrollment in Minnesota high schools has been similar to that of other states. The increase in state high schools was from 44,491 in 1917-18 to 49,060 in 1919-20. With this increase in total school enrollment the number of students taking physiography, botany and zoology has steadily decreased. In 1915 botany enjoyed the largest patronage of any science except chemistry; by 1920 enrollment in botany had diminished by nearly one-fourth. During the same time the number of students taking physiography and zoology each diminished by approximately one-third. The number in physiology remained nearly constant. Contrasted with this there were more than twelve times as many students taking general

5 Twenty-seventh Annual Report of the Inspector of Minnesota High Schools for the School Year Ending June 30, 1920, p. 41.

science in 1920 as in 1915, and the increase from 1919 to 1920 was by more than 1,000 students. Biology, which was not listed in 1915, was offered to 889 students in 1920. It is clear that during this five-year period administrators were showing increasing discontent with physiography, botany and zoology. At the same time general biology had found a place and there was a marked increase in the offering of general science. Chemistry and physics are for the most part eleventh and twelfth grade subjects and electives. The number of students taking these subjects was comparatively large and fairly constant throughout the five-year period.

That the term of enrollment in science in Minnesota is similar to that for entire country is shown by Table IV. This shows the per cent of students enrolled in high school who were pursuing each of the natural sciences at different periods since 1900.

TABLE IV.

Percentages of pupils in high school pursuing the study of each of the natural sciences. From the Reports of the United States Commissioner of Education.

	1889-1900	1904-05	1909-10	1914-15	1920-21
Astronomy	2.78	1.22	.53	.28	.10
Physics	19.04	15.66	14.61	14.23	8.59
Chemistry	7.72	6.76	6.89	7.38	8.88
Physical Geography	23.37	21.52	19.34	14.58	2.68
Zoology	....	....	8.02	3.21	1.23
Botany	....	....	16.83	9.14	2.89
General Biology	....	....	....	6.90	8.96
Geology	3.61	2.34	1.16	.48	.17
Physiology	27.42	21.96	15.32	9.48	4.61
General Science	....	....	....	....	14.84

Figures for 1920-21 are for schools in cities having a population of 100,000 or more. This tabulation shows that the decrease in enrollment in the special sciences which have commonly been offered in the first and second year of high school has been considerably larger for the country as a whole than for Minnesota. Notice particularly the figures for physical geography, physiology, botany and zoology. Similarly to Table III, Table IV shows a marked increase in number of students pursuing the study of general science and general biology.

A recent recommendation of the State Department of Education in Minnesota will, when it becomes effective, define with definiteness the fields in which training is demanded. This recommendation is in harmony with the evolutionary trend

shown in the above tables. It is for the traditional four-year school:—

General science a constant for the ninth grade.
General biology a constant for the tenth grade.
Physics an elective for the eleventh or twelfth grade.
Chemistry an elective for the twelfth or eleventh grade.
Additional electives for the eleventh and twelfth grades may be offered in the larger schools.

The enrollment figures, together with this recommendation, serve to define the position of teacher of natural science in Minnesota. The program of training must be planned to meet the needs of this position.

One further consideration will add concreteness to this definition. Enrollment figures show that the demand is largest for teachers of general science. It is proper to enquire what should constitute the subject-matter training for teaching this subject. An answer is found in an examination of the texts used in this course. The table below shows the number of the total pages in 18 text books that were devoted to the subject matter of each of the special sciences.[6] The content of general science is selected from each of the special sciences. It must follow, therefore, that adequately trained teachers will have had some contact with each of the subjects from which the content is chosen.

Pages of the total in 18 textbooks of general science which were devoted to each of the special sciences.

	Pages
Physics	2,212.5
Physiography	1,264.5
Biology	908.0
Physiology	885.5
Chemistry	632.0
Household Art	343.5
Astronomy	271.5
Miscellaneous	120.5

Teacher training for the field of natural science calls for preparation in physics, biology and chemistry. The large proportion of physiography in the general science course and the fairly large though decreasing offering of this subject, suggests the advisability of some work in this field. A point which should be emphasized is that the field of natural science in secondary education, which has not been defined with definite-

6 Webb, H. A. General science Instruction in the Grades, p. 9.

ness, is definable just as the fields of mathematics and English are definable. Improvement in instruction in natural science will result if teachers in training can be made to see the field and to plan their preparation for work in it.

That the field as defined is but poorly recognized by teachers in service and by teachers in training, is shown by an examination of the programs of science teachers and by an examination of the programs of students preparing for such service. Table V[7] shows the programs of 60 science teachers and includes those of all science teachers in the 41 cities taken alphabetically from Ada through Chisholm (Minnesota).* Seventeen of the 60 teachers have a program which is entirely within the field of natscience. Thirteen others have a program which includes only science and mathematics. Fourteen additional programs are of science with one other subject. In 6 of these 14 cases the other subject makes up the major part of the program. There is little or no tendency for the combinations to be recurring; eight different combinations are represented in the 14 cases. The remaining 16 of the 60 original cases are combinations of science with two or more other subjects. There is in Table V abundant evidence to show that in many cases the field of natural science is not recognized in assigning teaching programs. Certainly many of the teachers whose programs are given are teaching subjects which they are ill prepared to teach. Such impossible subject combinations are no doubt the occasion for much poor teaching.

Information concerning the subject-matter preparation of students for service as science teachers was obtained from the registrar's records at the University of Minnesota. There were nine students in the graduating class of 1921 who were granted special certificates to teach a natural science. The small number suggests at once the need of propaganda for the purpose of attracting more teachers into the field. Furthermore, the subjects offered for graduation by most of these students is poor preparation for the service which the high schools will demand of them.

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7 Programs taken by M. E. Haggerty from the records of the Minnesota State Department of Education. (Used by permission.)

* These were mostly small schools, the kind in which teachers ordinarily secure their first experience. The largest high school enrolled 412 students; there were but 8 of the 41 in which the enrollment was more than 200. It appears from Table VII, below, that the teaching combinations are somewhat more intelligently assigned in the larger than in the smaller schools.

TABLE V.

Programs of sixty Science Teachers in Minnesota High Schools, taken from the High School blanks in alphabetical order, including towns Ada through Chisholm.

Teacher	Period I	II	III	IV	V	VI	VII	VIII
1	Modern History	Vacant	Biology	Biology Laboratory	Economics	Assembly	Vacant	American History
2	Chemistry Laboratory	Chemistry	Vacant	Assembly	General Science	Vacant	Boys' Gymnasium	Geometry
3†	Geometry		Physics	Physics				
4	English	Economics		Zoology		Modern History	Ancient History	
5	Geometry	English	Botany	Civics		Algebra		
6†		Algebra		Manual Training	Physics			Commercial Law
7	General Science		General Science	English	Chemistry		Biology	
8	Geometry	Chemistry		Geometry			Physics	
9	Manual Training	Manual Training	Physics	Physics	Manual Training	Manual Training	Manual Training	Manual Tralning
10	Chemistry	Laboratory	Chemistry		General Science	Laboratory	General Science	
11		Physics	Laboratory	Physics	Physics	Laboratory	Physics	
12	Botany		Botany	Latin	Biology	Laboratory	Biology	
13		Home Economics	Home Economics	Chemistry	Home Economics	Home Economics	Home Economics	Home Economics
14	English	English		European History	General Science	General Science		
15	Chemistry	Chemistry	General Science	General Science	Chemistry	Chemistry	Physics	
16	Modern History	General Science	Physiology	Physiology			English	American History

†Superintendents who are teaching. *Principals who are teaching.

17	Chemistry	Chemistry			Algebra	Algebra	Biology	Geometry
18*	Assembly	Assembly	Physics	Laboratory		General Scieuce	Assembly	
19	Physiology	Biology	Laboratory	Physiology	Biology	Biology	Laboratory	
20	Chemistry	Laboratory	Physiology		Chemistry	Laboratory	Chemistry	
21	Chemistry	Chemistry	Algebra		General Science	Plane Geometry	Physics	Physics
22†	Latin				Algebra		Laboratory Physics	Physics
23	Ancient History	Biology		Library	Library	American History	Library	Ancient History
24†	Ancient History					Physics Laboratory	Physics	Psychology
25†		Economics		General Science	Phsyiology			
26	Home Economics	Home Economics	Home Economics	Home Economics		Chemistry	Chemistry Laboratory	Chemistry
27	Biology	Biology	Chemistry		Physics		Arithmetic	
28	Chemistry	Chemistry	Physics	Physics	Physics	Physics	Chemistry	Chemistry
29	Zoology		General Science	General Science	Zoology	Zoology		General Science
30	General Science	Elementary Science	Elementary Science		Physi-ography	General Science	Elementary Science	
31		Geometry	Algebra	Ancient History	Assembly	General Science	Assembly	Commercial Arithmetic
32	Physics	Laboratory	Agriculture	Agriculture	Agriculture			Assembly
33†				Algebra	Algebra		Chemistry	Chemistry
34†		Chemistry	Chemistry			American History		
35	Assembly	Geometry		Algebra	Physio-graphy	Phyio-graphy	Physics	Physics Laboratory
36	Chemistry	Chemistry	Physics	Physics		General Science	General Science	Physio-graphy
37†				Physics			Economics	General Science
38	General Science	Geometry			Physics	Laboratory	General Science	

39†	General Science	General Science		Algebra				
40†	Chemistry	Laboratory						
41	Geometry	Arithmetic	Geometry	Algebra	Zoology			
42	Physiology Botany		Physics	Physics	Chemistry	Chemistry	Physics	Physics
43	Physics	Physics	Physics			Chemistry	Chemistry	Chemistry
44	General Science	Zoology		English	Civics		Zoology	Civics
45	English	Assembly	Modern History	English		Zoology	English	
46	Algebra	Geometry	Chemistry	Laboratory	Civics	Algebra	Commercial Geography	
47	Chemistry	Chemistry	Assembly	Gymnasium	Physics	Physics	Chemistry	Chemistry
48†			Chemistry	Chemistry			General Science	
49	Chemistry	Chemistry Laboratory	General Science	General Science	Physics	Physics Laboratory		
50	History	Biology	Biology Laboratory			Ancient History		General Science
51†	Chemistry	Chemistry						
52*	General Science			English		English		
53†		Physics			Algebra		Physics	
54*	Algebra			Latin	Chemistry	Chemistry	Latin	
55	Algebra	Algebra	Chemistry	Chemistry	General Science	Physiology	Business Arithmetic	
56	Assembly	English	English	General Science	Assembly		Chemistry	
57	Physics	Physics	General Science		Chemistry	Chemistry Laboratory	Chemistry	Chemistry Laboratory
58†				Algebra	Algebra		Chemistry	Chemistry
59*	History	General Science		Commercial Geography	General Science		Modern History	
60	Physics	Physics	Manual Training	Manual Training	Manual Training	Manual Training	Manual Training	Manual Training

Table VI shows the subjects in which they had major and minor (if any) preparation and the subjects in which they had taken sufficient training to enable them to teach with some degree of proficiency. There is almost no tendency in evidence to prepare to teach a combination of subjects within the field of natural science. Apparently elections are made promiscuously. No guiding principle has operated to direct students to prepare to teach a combination of botany and history, botany and Latin, or botany and political science. Such combinations can result only from chance, or from the popularity of certain college departments or college teachers.

TABLE VI.

Student	*Major*	*Minor*	*Fair Preparation to Teach*
A....	Botany	History	Social Science, Romance Language
B....	Zoology	none	Social Science, German, Mathematics
C....	Botany	Political Sci.	Social Science, Romance Language
D....	Zoology	Botany	Mathematics, Scandinavian, Chemistry
E....	Botany	Latin	Mathematics, Social Science
F....	Botany	none	Romance Language, Zoology, Chemistry, English
G....	Botany	History	Geology
H....	Botany	none	none
I....	Chemistry	Physics	Mathematics, Scandinavian

That these students have made an unfortunate selection of a major subject is evident from enrollment figures already presented. This evidence is supplemented by data in succeeding tables. Notice that eight of the nine students of Table VI had major preparation in either botany or zoology, and that but one of the eight had taken minor training in any natural science. Koos and Woody have shown that there is very small chance for a beginning teacher to secure a position as teacher of a single subject in Washington.[8] Table VII shows that at least for natural science and particularly botany, a similar situation exists in Minnesota.[9] This table shows the number of teachers in high schools of Group I (having more than 30 teachers), Group II (having 10 to 29 teachers), Group III (accredited schools with less than 10 teachers), and Group IV

8 Koos, L. V. and Woody, Clifford. The Training of Teachers in the Accredited High Schools of the State of Washington. The Eighteenth Year Book of the National Society for the Study of Education, pp. 213-257. (See especially Table IV, p. 221.)

9 This table is reproduced from the article already cited by Huston, P. W. Information in Table VII was obtained by questionnaire.

(schools only partially accredited), who taught each of the sciences as a single subject, and as a two, three, or more subject combination.

No teacher reporting taught zoology as a single subject, and but one teacher reporting from Group I (largest) schools and one from Group II schools taught botany as a single subject. Biology was taught as a single subject by but one teacher in

TABLE VII.

Percentage distribution of the science subjects to show the extent to which they appear singly and in combination in four groups of schools.

Subject		No. of Teachers	Percentage of Times Each Subject Appears						
			As a single subject	In a 2-subj. comb.	In a 3-subj. comb.	In a 5-subj. comb.	In a 4-subj. comb.	In a 6-subj. comb.	In a 7-subj. comb.
Chemistry	I	13	30.8	30.8	30.8		7.7		
	II	26		38.5	46.2	11.5	3.8		
	III	37		21.6	35.1	35.1	2.7	5.4	
	IV	13		15.4	15.4	38.5	15.4	15.4	
Physics	I	15	46.7	40.0	13.3				
	II	27		40.0	40.7	11.1	3.7	3.7	
	III	36		27.8	30.6	38.9	2.8		
	IV	13		15.4	30.8	30.8	15.4	7.7	
Botany	I	6	16.7		66.7		16.7		
	II	8	12.5		25.0	62.5			
	III	13		15.4	15.4	38.7	15.4	7.7	7.7
	IV	16			6.3	25.0	43.8	25.0	
Zoology	I	3			66.7		33.3		
	II	3				66.7	33.3		
	III	16		6.3	31.3	37.5	18.8	6.3	
	IV	7		14.3		14.3	42.9	28.6	
Physiography	I	5		20.0	60.0		20.0		
	II	5		20.0	40.0	40.0			
	III	11		9.1	18.2	36.4	27.3	9.1	
	IV	17			11.8	58.8	11.8	11.8	5.9
General Science	I	16	18.8	25.0	56.9				
	II	32	12.5	18.8	40.6	25.0	3.1		
	III	45		20.0		35.6	2.2	4.4	
	IV	18		5.6		11.1	38.9	5.6	
Physiology	I	3		33.3	33.3		33.3		
	II	8			37.5	50.0	12.5		
	III	14		21.4		42.9	21.4	14.3	
	IV	14		14.3	21.5	21.5	28.6	7.2	7.2
Biology	I	9	22.2	33.3	44.4				
	II	9		11.1	66.7				
	III	18		5.6	33.3	5.6	5.6		
	IV	3			33.3				33.3
Natural Science	I	43	72.1	25.6	2.3				
	II	58	46.6	41.4	6.9	3.4		1.7	
	III	106	12.3	49.1	24.5	12.3	.9		.9
	IV	63	1.6	17.5	39.7	27.0	14.3		

the largest schools. In Minnesota there is but little chance for either experienced or inexperienced teachers to teach botany or zoology as a single subject. On the other hand, a fair proportion of the teachers of physics and chemistry taught these as single subjects. It should be noted, too, that the gross number of teachers of physics and chemistry is much larger than of botany and zoology. When Table VI is placed alongside Table VII, it is evident that teachers by taking major preparations in botany and zoology are preparing for positions which do not exist, and that by neglecting the physical sciences (physics and chemistry) they are failing to prepare for positions for which the supply of teachers is entirely inadequate.

The need for teachers trained to teach a combination of science subjects is illustrated by Table VII. The last division of the table shows that in the larger schools (Group I) there were 43 teachers teaching some natural science. Of these, 72.1 per cent were teaching only natural science subjects. There was but one of the 43 teachers that was teaching a combination of more than two subjects, if the subjects within the field of natural science are grouped as one. The combinations are less satisfactory in the smaller school. Most ambitious teachers who begin work in small schools look forward to promotions to positions in larger ones. The marked tendency of the larger schools to assign combinations of the sciences makes it appear that the breadth of the teacher's training in science is a factor of no small consequence for determining fitness for such promotions. Furthermore, it must follow that teachers with a broad preparation in natural science are more likely to receive an assignment of subjects which fits their preparation. The unfortunate combinations are assigned to those with narrow and possibly highly specialized training.

Data in Table VIII makes an additional contribution to the definition of needs for training of science teachers. This table shows the total number of teachers in the accredited schools of Minnesota who taught each of the sciences during the school year 1921-22. It also shows the total time equivalent, that is, the number of full-time teachers that would be required to teach each subject, the fraction which the total time equivalent is of the total teachers' time (index number; the number of full-time individuals; number without experience, and the me-

dian experience of each group of teachers.[10] There were, for example, 82 individuals in the state who were teaching biology. The time devoted to teaching biology was equivalent to that of 30.84 full-time individuals. In other words, .37 of the total teaching time of the 82 teachers was devoted to this subject. There were 8 full-time individuals; 21 without experience; and the median experience of the group is 2.4 years. Corresponding figures for English, Mathematics, History, and Manual Training are added for comparison. It is evident at once that teachers of science have less chance than teachers of other subjects to devote full time to their specialty.

TABLE VIII.

Subject	*Total Teachers*	*Total Time Equivalent*	*Index No.*	*Full Time Individuals*	*Without Exp.*	*Median Exp.*
Biology	82	30.84	.37	8	21	2.4
Botany	35	12.77	.36	3	3	4.5
Chemistry	187	82.91	.44	12	33	3.3
General Science..	242	85.00	.35	22	48	2.8
Physics	187	77.52	.41	20	29	3.5
Zoology	31	7.69	.24	0	7	2.4
English	727	560.65	.77	322	109	4.3
Mathematics	506	281.18	.55	158	54	5.2
History	486	245.16	.52	108	83	3.8
Manual Training.	140	112.46	.80	72	21	3.4

Both of these tables (VII and VIII) point to the conclusion that there is but little coincidence between the training taken by students of the graduating class of 1921, who were preparing to teach science, and the positions which were open to them in the state. For the six teachers who had major preparation in botany there were but three positions. (Table VIII shows that there were but three inexperienced botany teachers that began work in the state in September of 1921.) It follows that at least half of the students trained to teach botany either accepted a position as teacher of some other subject, went outside the state, or failed to secure a position. Two of the nine students had major preparation in zoology. Seven positions were filled in the state in which part time was given to teaching this subject. Note however, that the outlook in this field is anything but promising, for there are no full-time teachers in zoology in the state and less than one-fourth of the total teaching time of teachers of zoology is given to teaching this

10 Haggerty, M. E. The relation of Departments of Education to Other Departments of College or University. Educational Monographs, Number XI (1922), pp. 65-82 (see especially page 66). The data in Table VIII were taken from the records in the office of the State Department of Education.

subject. The term biology, as used in the State Department records, is not clearly defined. It may mean general biology or it may mean courses which are botany during one part of the year and zoology and possibly human physiology during another part of the year. Twenty-one inexperienced teachers of "biology" began work in the fall of 1921. It is evident though, that the training of the students of Table VI was insufficient for these positions, for but one (possible two) of the nine teachers had taken adequate preparation to teach both botany and zoology.

The demand for teachers of general science, physics and chemistry was comparatively large, and not met at all. Not one of the students was in any way adequately prepared to teach general science, and but one was trained in chemistry and physics. In spite of the failure of the state university to train their students for this work, the schools of the state demanded and employed teachers of these subjects. There is no escape from the conclusion that many, probably most, of these teachers were very poorly prepared for their work. With these facts before us, there is little wonder that administrators and supervisors are complaining that science is less well taught than other high school subjects. The larger aspects of a program of educational guidance of teachers of science are defined by this contrast of positions open and the training of possible candidates for these positions.

The work for which science teachers should prepare has been defined in terms of: (1) enrollment figures at a given time; (2) the trend of enrollment figures over a period of time; (3) the recommendation by the Minnesota State Department of Education of the science subjects to be taught; and (4) the content of the general science course. It has been shown for Minnesota that physics and chemistry are the only special sciences which make any considerable demand for teachers. Only a few of the teachers of these subjects are able to devote full time to teaching a single subject. The increasing offering of general biology and the decreasing offering of botany and zoology indicate that teachers prepared for the general field face much better opportunities for service than those prepared for but one of the special biological sciences. The large offering and the large increase in the offering of general science indicates that the demand for teachers of this subject is largest.

Preparation for service in this field demands some study of each of the major divisions of science, including physics, chemistry, physiography, and the biological sciences. Since there is very little chance for natural science teachers, especially beginners, to secure positions in which they will give full time to the teaching of the subjects in which they have major preparation, students should plan their work so that they will be able to teach a combination of the science subjects. It is fortunate that the training in subject matter which fits teachers for general science is at the same time that which prepares them for a combination of science subjects.

An examination of the programs of science teachers has shown that most of the teachers in Minnesota are teaching some combination of subjects. Except for combination with mathematics there is no marked tendency in the smaller schools for the combination to be recurring. The programs of teachers in training show that there is almost no tendency for students to plan their training so as to fit themselves for teaching a combination of science subjects. The promiscuous assignment of subject combination is a resultant of the failure of teachers in training to plan their work for the definite field. Unfortunate teaching combinations and unfortunate preparation combinations supplement each other as underlying causes of much poor teaching. The situation in Minnesota is no doubt typical of the situations existent in the mid-western states and is in large part typical for the entire country. A program of teacher training which will result in correction of this discrepancy will greatly improve the teaching of science.

The outstanding need is for a grouping of training subjects so that graduates will be prepared for the subject combinations for which teachers are demanded. In order to meet this need the University of Minnesota has outlined a special curriculum for the training of teachers of natural science. In this recognition is given to the need for some contact with a number of the special divisions of science. At the same time the curriculum requires rather specialized training in one science. Students following this curriculum have considerable time for free electives. Only 65 of the 180 hours required for graduation are prescribed in natural science. Although the requirement of the major represents a more thorough training than that of the majority of teachers in service, it is recognized as

inadequate for most satisfactory service. Students should be encouraged to take more training in their major than the minimum suggested. The curriculum is sufficiently flexible to permit of genuinely intensive training in one field. The requirements, as they are given in the Bulletin, are as follows:[11]

1. Completion of 30 hours (quarter hours) of work in one of the four natural sciences: chemistry, botany, animal biology, physics. (On account of the mathematics requirement, students majoring in physics may satisfy the requirements by offering but 25 hours.) The subject chosen is called a major.
2. Completion of 15 hours (quarter hours) in one of five natural sciences: chemistry, physics, botany, animal biology, geology. The course elected is called a minor.
3. Completion of introductory courses in two of three of the courses named under (2) and not selected as major or minor.
4. Completion of 10 hours (quarter hours) in chemistry.

Students who elect this curriculum must, in addition to the requirement in natural science, meet all the requirements of the College of Education. The curriculum leads to the degree of B. S. in Education. Students who complete it receive the degree and are given a special certificate to teach natural science.

This curriculum is not a final solution to the problem of training teachers of natural science. It is presented here because it seems to suggest the subject combinations which students preparing to teach in the field of natural science should take. It has been shown that there is a great discrepancy between the training offered by science teachers and that which is demanded by the positions open to them. The training offered is commonly highly specialized and confined to the field of one of the special sciences. The positions open demand broad training,—training in the major divisions of physical science plus training in the biological sciences. The demand for intensive training is increasingly larger. This curriculum suggests for the student a workable program for securing the preparation which will approximate that demanded by the position which he will fill after he leaves the university.

11 The Bulletin of the University of Minnesota, The College of Education Announcement for the Year 1922-23, pp. 39-41.

The Curriculum in General Science

Mybert E. Broom, Champaign, Illinois.

Science instruction in the first year of the senior high school has presented a serious problem. The history of the many attempts to fit the special sciences into the ninth grade is well known. As a result of these experiences, the conviction has arisen that no one science is adequate for the introductory course in science in the secondary school. Many textbooks have been developed, all based upon the conviction that the first year of science in the secondary school should be fundamental to all the sciences.

Recently the writer undertook a careful study of two such textbooks. The primary purpose in this investigation was to discover the facts included in each textbook, the curriculum. While the investigation is not of sufficient scope to warrant general conclusions, the method may be of value to teachers of general science who are interested in curriculum construction, and to supervisors concerned with the training of teachers in service and with the selection of textbooks in general science. An effort will be made to present the limited data in such a way as to make clear the facts obtained.

The first of the textbooks[1] states that "the object of the course is to develop a usable fund of knowledge about the common things and helpful and trustworthy habits of considering common experiences in the field of science. It is expected that pupil's interests and abilities will be discovered and utilized in such ways that more effective and more profitable work may be done in the vocations or in later studies." No attempt is made in this text to preserve the unity of any one of the different sciences; unity is secured by the logical interrelations between the topics which compose the course. These topics are readily grouped under six major divisions: (1) the air; (2) water and its uses; (3) work, energy, and electricity; (4) the earth in relation to other astronomical bodies; and (5) the life upon the earth. The course presented in this textbook is, the authors tell us, the result of ten years of experimentation in secondary schools.

1 Caldwell, O. W. and Elkenberry, W. L., General Science, Revised Edition. Boston, Mass., Ginn and Company, 1918. Preface, p. iii.

The second of the textbooks to be used in this study[2] has for its purpose not so much the development of the subject alone as the development of the pupil. "The scientific information will enable him to appreciate better the natural phenomena going on around him. The scientific training should enable him to observe more accurately, to interpret more sanely, to understand the vital importance of everyday affairs, and to train him to apply acquired knowledge to useful ends."

The authors of this book present it, stating that "it meets these fundamental requirements, first, in providing a ground work in physics, chemistry, botany, zoölogy, physiology, and physical geography; and, second, that it has stood the test of time." The course as presented represents the results of fifteen years of classroom instruction in general science. Subject unity is preserved throughout the textbook.

The method of the study is one of analysis to discover the material common to both textbooks and then to present this material in the form of statistical tables. As in any analysis of textbooks, it is necessary to assume that the authors are qualified to express expert opinion. Of course, the opinion of experts does not always agree on all points.

The unit used for measuring the amount of material relative to each topic for this study was the square inch. This work was carefully done. In some cases where several illustrations appeared, it was necessary to make a number of computations. Printers' estimating tables were used in obtaining the number of words per square inch for each of the several sizes of type used in each text. The amount of space given to diagrams, pictures, statistical tables, and other illustrative material was recorded separately from the amount of space devoted to print on each topic.

It should not be understood that emphasis as shown by the amount of space devoted to the different topics gives the approximate relative importance of the several topics. The method has both values and limitations. It permits of a careful analysis of the material presented, and of a collection of all the information from the sources examined, but it introduces certain errors, those due to the necessary reliance upon expert opinion, and certain variable errors through the use of tables for obtaining the word count.

2 Weckel, A. L. and Thalman, J. L., A Year in Science. Chicago, Ill., Row, Peterson and Company, 1916. Preface, p. v-vi.

An actual comparison between the estimated word count for six pages of each textbook examined and the actual number of words on each of the pages showed that the variation is comparatively small, and that the error may be either positive or negative. Errors due to sampling may be found in the study only in connection with the comparison noted in the above paragraph. In general, the method was used as the best available which was suited to the conditions connected with the study.

It was necessary to determine arbitrarily the placement of certain subject material for the statistical study. For instance, there was some question as to the placement of certain paragraphs treating with matter. The writer carefully read passages on the subject in several physics and chemistry textbooks, grouping the subject material with that to which it was most closely related in treatment, physics.

Since it is impossible to present in detail the tables of crude data which represent the most of the statistical study, a summary table is given below.

	CALDWELL AND EIKENBERRY			WECKEL AND THALMAN		
	No. of words	Sq. in. of illustrations	Quantitative rank	No. of words	Sq. in. of illus. trations	Quantitative rank
Astronomy	10,826	128.37	5	0	0	0(8)
Botany	12,946	187.99	4	7,588	257.83	5
Chemistry	3,636	25.95	7	11,311	152.82	3
Physical Geography	17,521	346.02	2	12,021	230.25	2
Physics	35,113	567.69	1	9,650	132.39	4
Physiology	7,903	72.86	6	25,097	215.36	1
Zoology	2,360	16.19	8	7,539	437.29	6
Miscellaneous	16,478	287.83	3	2,669	32.18	7

The preceding table shows rather inadequately the wide differences in the subject matter of the textbooks examined. Since it is impossible in this short report to go into detail in the matter, physical geography, the one subject concerning which agreement in quantitative ranking in the two textbooks was found, was chosen for a more detailed discussion.

Both textbooks unite in the presentation of facts concerned with weather and climate, winds and storms, the surface of the earth, erosion by water and air, and soil water and drainage. Caldwell and Eikenberry also discuss the seasons, day and night, and the climatic influences of large bodies of water. In general, agreement was high when the treatment of the subject is compared with that for other subject material found in the two textbooks.

Certain limitations in a study of this nature, those due to the method of procedure followed, have already been pointed out. The conflict of opinion as to what is worth while for inclusion in a textbook for general science classes presents another serious limitation. In but three of the eight topics treated is there anything like close agreement.

Authentic information as to the frequency of use of textbooks examined in a study such as the one reported here, norms of standard tests and scales for use in teaching general science, and a careful analysis of a number of additional textbooks would probably yield a more satisfactory basis for curriculum revision in general science. Certainly much remains to be done in the field.

Results of an Objective Standard Test on Weather

E. F. OTTMYER, York High School, York, Pa.

DURING the past year an objective test has been worked out in the York High School, York, Pa., which is a source of considerable information in the handling of classes in General Science. The York High School is a general high school with four courses, classical, scientific, commercial, and industrial, each requiring four years of work. General Science is taught in the first year to approximately 500 pupils, four teachers doing the work. It was desired to give a test in General Science to determine a pupil's progress compared with his ability, to compare progress of commercial, scientific, industrial, and classical pupils, and to compare progress of boys with that of girls. It was considered unnecessary to develop the whole of General Science; weather is taught for about six weeks and it was chosen for the experiment.

In determining the subject matter of the test sixteen textbooks of General Science and Physical Geography were examined. Sixty-three questions were drawn up as being quite comprehensive and these were investigated in the list of books following (the number before the title in parenthesis indicates how many of the questions were touched upon in the particular text):—

(63) "An Introduction to the Study of Science"—Smith and Jewett.
(57) "First Course in General Science"—Barber.

(34) "An Introduction to Science"—Clark.
(29) "Science of Home and Community"—Trafton.
(49) "General Science"—Caldwell and Eikenberry.
(56) "Everyday Science"—Snyder'
(57) "The First Year of Science"—Hessler.
(50) "General Science"—Bedford.
(38) "Science for Beginners"—Fall.
(44) "General Science"—Elhuff.
(24) "Common Science"—Washburn.
(47) "The Science of Everyday Life"—Van Buskirk and Smith.
(54) "Modern Geography"—Salisbury, Barrows, and Tower.
(61) "Elements of Physical Geography"—Hopkins.
(62) "New Physical Geography"—Tarr.
(59) "Physiography"—Arey, Bryant, Clendenin, and Morrey.

Forty of the original sixty-three questions were contained in at least ten of the above authors. These were therefore considered essential to the subject; and the tests, three in number, were drawn from these. Three types of questions were worked out, and hence three tests were necessary.

INFORMATION TEST NO. 1 (WEATHER).

(Underscore correct answer.)

1. Hail comes mostly in
   spring, summer, autumn, winter.
2. The greatest annual rainfall occurs in
   New England, California, Mississippi Valley, Great Lakes.
3. In this section storms move
   Northeast, Northwest, Southeast, West.
4. On a clear calm night with much moisture in the air, with the temperature 60 degree Fahrenheit, we will probably have
   snow, rain, dew, frost.
5. The gas in the air most necessary to human life is
   hydrogen, nitrogen, oxygen, carbon dioxide.
6. The instrument used to measure moisture in the air is the
   anemometer, thermometer, hygrometer, barograph.
7. Air becomes lighter when pressure rises, heated, cooled, dried.
8. The storm that is the most destructive is the
   cyclone, thunderstorm, anticyclone, tornado.
9. Humidity has to do with pressure, moisture, velocity, density.
10. A hurricane is a type of
    anticyclone, cyclone, tornado, thunderstorm.
11. Pressure of the air is measured by a
    balance, scales, barometer, anemometer.
12. Rain clouds are the cirrus, nimbus, stratus, cumulus.
13. Winds are caused by
    conduction, absorption, evaporation, convection.
14. Density refers to weight, hardness, pressure, temperature.
15. The gas in the air which is least active is
    oxygen, carbon dioxide, nitrogen, hydrogen.

Score: No. Right———

INFORMATION TEST NO. 2 (WEATHER).

(Underscore the two correct answers.)

1. Thunderstorms occur when the air is warm.
   in the morning mostly.
   when the air is moist.
   when the air is heavy.
2. As a cyclone approaches the temperature goes up.
   temperature goes down.
   pressure goes up.
   pressure goes down.
3. An anticyclone is a low.
   is a high.
   brings cloudy weather.
   brings clear weather.
4. The wind about a low spirals
   inward, outward, clockwise, counterclockwise.
5. A low pressure occurs in a
   cyclone, anticyclone, blizzard, tornado.
6. Precipitation refers to rain, fog, frost, snow.
7. If condensation takes place below 32 degrees Fahrenheit
   dew, snow, sleet, frost, will be formed.
8. Rain is formed by
   evaporation, condensation, convection, precipitation.
9. The fixed points on the Centigrade scale are 0-32-212-100.
10. Hail and lightning often accompany
    hurricanes, tornadoes, cyclones, thunderstorms.
11. Climates are named according to their
    clouds, winds, temperatures, zones.
12. A cloud is made up of smoke, fog, mist, dust.
13. When the air has all the moisture it can hold it is said to be
    dense, precipitated, saturated, at its dew point.
14. Rainy weather is indicated by falling temperature, falling
    barometer, southeast winds, bright sunset.
15. Thermometers are made out of alcohol, water, mercury, acid.

Score: No. Right———

INFORMATION TEST NO. 3 (WEATHER).

(Fill in the blank.)

1. A line drawn through places of equal pressure is called *isobar.*
2. The gas in the air most necessary to human life is *oxygen.*
3. Carbon dioxide in the air is used by *plants.*
4. The normal pressure of the atmosphere at sea-level is *14.7# per sq. in. or 30" of mercury.*
5. The temperature at which condensation begins is called the *dew point.*
6. On an average lows pass across the country in *4 or 5 days.*

7. The instrument used to measure the intensity of heat is called the *thermometer.*
8. When we speak of the weather we mean the condition of the *atmosphere at a particular time.*
9. Air pressure is caused by *weight or gravity.*
10. Winds blow from a *high* pressure area to a *low* pressure area.

Score: No. Right x 2————

The highest score possible from these tests is 50; to convert to a percent grade it is only necessary to multiply the total score by two. The tests were given to 459 pupils with the following results:

Score	Boys	Girls	Classical	Science	Com.	Ind.	Total Class
Highest	47	44	45	47	42	42	47
Lowest	9	13	18	22	9	12	9
Median	32	31	33	33	31	30	31
Average	30.15	30.66	32.51	32.00	29.77	29.66	30.97

The same pupils were given Terman Test "A" to determine ability. Since there was no way by which to determine the average scores for various ages in the weather test with any degree of accuracy with such a small number of pupils comparisons were made with the absolute scores only and not with the relative mental ages or I. Q's. The results of the Terman Test "A" are—

Score	Boys	Girls	Classical	Science	Com.	Ind.	Total Class
Highest	134	131	134	128	118	124	134
Lowest	67	67	74	67	73	78	67
Median	97	97	100	99	94	96	97
Average	98.55	97.31	100.16	101.27	95.03	95.22	97.59

The results of the test on weather parallel closely the results of the Terman Test "A". The highest and lowest scores were made by boys in the weather test; in the Terman Test a boy was high and the lowest score was held jointly by a boy and a girl. However, the boys and the girls averaged about the same in both tests.

The comparisons of the four courses were interesting. It was formerly thought that the pupils by choosing their courses automatically classified themselves. The results of the tests show this to be true. Classical and scientific groups are made up largely of those who expect to enter the colleges; the commercial and industrial groups are made up of those who will

enter offices and factories. The tests showed that the classical and scientific groups had scores in each test the highest, and the average scores for these groups were above the average scores of the commercial and industrial groups.

The scores made were used by each teacher to give individual attention; and all sections made charts of their own and the class scores to compare the section with the class, and to compare the individual's score with the section and the class. In this way considerable interest was aroused, and a motive for better work was formed.

Entrance Credit Given for Science by Colleges

A STUDY of college admission requirements reported by L. M. Fort in SCHOOL REVIEW for November, 1923, gives a number of facts relating to science and to general science which are of interest. In a study of science requirements in the North Central Association, comprising 141 colleges, 43 normal schools, and 18 junior colleges, the units of credit and the number of institutions giving the credit is as follows:

No. of units of science required.	0	0.5	1	1.5	2	2.5	3
No. of institutions	53	1	107	0	25	2	1
Percentage	28	0.5	56.6	0	13.2	1.1	0.5

The comparison of data on general science in this section with a report by L. V. Koos on requirements in 40 institutions in the East and 37 in the West, discloses the fact that the East is giving credit for general science less freely than institutions in other parts of the country, as the following table shows:

	Number of Institutions Giving Credit for General Science	Percentage
East	10	25
North Central	185	99
West	28	92

Fuels in the Home

Samuel S. Wyer, Associate in Technology, Smithsonian Institution.

Introduction.

One of America's big problems is its fuel situation. The data available on "correct use of fuel in the home," have been brought together from many sources, indicated by foot notes, and the salient facts compressed into the following pages. The urgent present need in our fuel crisis is not waiting for more research work, but a quick and wide diffusion and immediate application of the facts that we now have.

In particular, recognizing that:

1. Anthracite, although a natural monopoly from a geographical viewpoint, is not a monopoly from the point of use, since "man-made anthracite"—that is, coke—can easily be made to take its place and "Building up the demand for substitute fuel is one form of insurance against combinations of labor or of capital and the consequent rising prices.[1] Furthermore, the small sizes of anthracite—representing 29% of the total—and now sold to the steam trade at low prices, could easily be used in the homes with proper utilization methods.

2. Bituminous coal should never be used in its raw state. That is, the by-products should be separated and only the residue coke should be used for house heating. However, with correct firing of raw coal, much of the offensive smoke can be eliminated.

3. Natural gas is on the decline and the demand is greater than the available supply and should be used with care as manufactured gas must be used. It is worth twice any manufactured gas that can be made; therefore, 2 cu. ft. of manufactured gas will be required to replace 1 cu. ft. of natural gas.

4. Candle power standards[2] for manufactured gas are obsolete, of no value to the public and should be abandoned. Due to crude fuel and operating conditions, manufactured gas must rapidly go to a lower heating value standard so as to permit the use of fuels and processes not now available. In Pennsylvania, the beehive coke oven gas wasted is 4½ times the total amount of manufactured gas sold in the state.

1 U. S. Coal Commission Report on the "Anthracite Industry," July 5, 1923.

2 Candle Power is an artificially added property of gas, so that the gas may be used for illumination in an open-flame burner.

5. Oil is desirable for cooking and incidental house heating when gas is not available. But, because of operating limitations and inevitable future price conditions, will not come into general use for house heating.

6. Average house fuel use is grossly inefficient. The same service could be obtained with one-half the fuel.

7. Respiratory diseases increase during the heating season because of improper heating and ventilation.

8. Electricity for cooking and heating cannot solve the home fuel problem.[3] It would take about six times as much coal to generate electric energy for house heating as would be required to use the coal direct in the home. If the 46 million horsepower[4] of undeveloped water powers in the United States were fully developed, and this without regard to whether it was good business to do so, this total hydro-electric energy could heat less than 4% of our homes. The home heating problem must be solved by proper use of available fuels.

9. Central heating plants distributing hot water, steam or manufactured gas on a public utility basis, because of economic limitations cannot come into general use for universal house heating.

Since 16% of our coal, 40% of our natural gas, and 75% of our manufactured gas are used in our homes, the direct personal contact between the home and the fuel industry is obvious. The immediate carrying out of the instructions in this bulletin would prevent much needless suffering and save many million dollars now wasted by improper fuel use each year. It would also develop the sound public opinion that must be created, before the national fuel problem can be solved.

In particular, recognizing that:

PART I.

FUNDAMENTAL PRINCIPLES.[5]

Air to Burn Fuel.

The combustion—that is, burning—of every fuel is the chemical combination of the ingredients in the fuel with oxygen of

3 For further discussion see "Salient Features of Electric Cooking, Electric Hot Water Heating and Electric House Heating," Samuel S. Wyer, Columbus, Ohio, 31 pp.

4 Estimate of U. S. Geological Survey 79 per cent of this is on or west of the Rocky Mountains.

5 Summarized, largely verbatim, from U. S. Bureau of Mines Technical Papers 97, 137, 180, 199 and 208; University of Illinois Experiment Station, Urbana, Illinois, Bulletin 29; Kansas State Agricultural College, Manhattan, Kansas, Bulletin 8; and U. S. Department of Agriculture Bulletin 1194.

the air. Different fuels require different quantities of air and applied in different ways.

One pound of coal (21 cubic inches) requires about 15 pounds (200 cubic feet) of air. That is, the volume of air is, in round numbers, about 16,000 times the volume of coal.

One gallon of oil (7½ pounds, 231 cubic inches) requires about 142 pounds (1,866 cubic feet) of air. That is, the volume of air is, in round numbers, about 14,000 times the volume of oil.

One cubic foot of natural gas requires from 9 to 10 cubic feet of air and one cubic foot of manufactured gas from 4 to 5 cubic feet of air.

Efficient fuel use can be secured only by the use of the correct amount of air and applied in the right way; as this is entirely in the hands of the fuel user, the importance of correct information is obvious.

Dampers to Control Air.

No general rule can be given for the exact adjustment of dampers, but proper adjustment must be ascertained by trial with each installation.

The "draft damper" of the furnace—usually controlled by a chain from the living room—is generally a lift door in the ash pit door and admits air underneath the fuel.

The "feed-door damper" consists of a slide in the feed door and admits air directly over the fire. If opened too wide it acts as a check.

The "smoke-pipe damper" will control the draft or "drawing" of the chimney and should always be placed between the furnace and the check damper and never between the check damper and the chimney flue.

The "check damper"—usually controlled by a chain to the living room—can admit cold air into the smoke pipe, reducing the chimney draft and retarding the burning of the fuel in the heater. This damper should be closed tight when fresh fuel is added to the fire.

What Must Happen When Fuel is Burned.

The burning of fuel with perfect combustion will produce carbon dioxide—the same substance that is exhaled from the lungs—and water vapor. If the combustion is not perfect, carbon monoxide—a poison—and condensible vapors and smoke will be formed.

No heating device has or can be made that will absorb its combustion products, hence they must be properly removed from the house by adequate flues.

Proper Flue Equipment.

An opening should be provided at the base of all chimneys for occasional cleaning. Solid fuels require larger connections than gas or oil. When bituminous coal is used, horizontal sections of flue pipes require frequent cleaning.

With gas, the large amount of steam that must be formed when the gas is burned may give trouble in disintegrating the mortar lining of the ordinary chimney. This moisture is acid and will soon corrode ordinary thin black stove pipe; galvanized connections only should be used and flues should preferably be lined with a moisture proof lining like heavy steel galvanized pipe.

Back or down drafts with solid fuels can be prevented by a hood at the chimney top; with gas, an opening at the bottom of the smoke pipe near the heater will protect.

Waste in Ashes.

Tests show that ashes frequently contain 50% of carbon. This is because the grates do not receive proper attention. In shaking grates, stop when the fire glow from above appears and before live coals go into the ash pit.

Never leave ashes under the grates after shaking. Remove at once, as this will protect grates and give better circulation of air.

Burning Fuel Merely First Step.

Even with proper combustion of fuel, the heating problem is only partially solved. The big task is getting the heat into the room, water or food that is to be heated in the most direct and effective manner.

The ordinary furnace of water heater for the average house does not have enough heat absorbing surface, with the result that the combustion products go into the chimney at too high a temperature and much heat is needlessly lost. This is especially marked when gas or oil are burned in the ordinary coal furnaces.

Needless Radiation Losses.

Water tanks, furnaces and pipes for hot air, water or steam should be adequately insulated. Merely covering—as is frequent—with one thin thickness of asbestos sheets is not enough, in fact this is worthless. The covering must be about ½ inch

thick to be effective and will then make a marked saving in fuel.

Gas ovens should be adequately insulated because an insulated oven will give the same service with about one-half of the gas and at greater comfort to the cook.

Temperature Control.

A thermostat is a device for controlling fuel burning so as to maintain a pre-determined temperature in a room, water tank or oven. Its use will always promote fuel economy, saving from 15% to 30%. For room heating it contributes to the good health and comfort of the occupants. Applied to a gas oven it results in saving in burned food, takes the "guess" out of oven cooking and insures duplication of results.

Lower House Temperatures Desirable.

Most houses are kept too warm. About 25% of the house fuel is used in raising the room temperature from 60° to 70°. Houses can be kept 5° to 10° lower than is customary—that is, kept at 62° to 68°—without any discomfort or any danger to health.

Keeping the house temperature lower is the easiest way to save fuel. It is fuel saved by doing less work.

Proper Humidity.

In most houses—especially when hot-air furnaces are used—the room air is too dry for health and comfort. That is the "moisture content" called humidity is too low. A room with proper humidity of air—not less than 30%—will be more comfortable and healthful at a low temperature, than one where the moisture content is too low. Therefore, with proper humidity lower temperatures may be comfortably maintained and less fuel used.

The humidifying equipment usually available is grossly inadequate. For instance, with zero temperature of intake air, to maintain 40% of relative humidity, with the room temperature at 70° F., for 9,000 cu. ft. of air per hour—which would be proper for an average size house with a family of five—it would be necessary to evaporate about one-half gallon of water per hour.

Proper Cold-air Inlet to Furnace.

Most hot air furnaces take their cold air only from the outside. This is wrong. When the basement is clean, by merely taking the air out of the basement—at least in severe and windy weather—a saving of 20% to 30% in the fuel required to heat

the house can be made and the house kept more comfortable.

There is nothing novel in this. Hot air furnaces have been installed on this plan for many years; the only surprising feature is that all furnaces are not installed in this way, instead of an occasional one.

Ventilation.

In homes, one complete change of air an hour in an occupied room is adequate and the outdoor air leaking in—through cracks in floors, walls around windows and doors and through porous walls—is not objectionable. However, during high winds there may be as many as five changes of room air each hour. This not only wastes fuel but may make adequate heating impossible.

Each person exhales about 6 tenths cu. ft. of carbon dioxide per hour. The carbon dioxide content in a living room should be kept below 7 parts in 10,000 by ventilation. About 1,800 cu. ft. of fresh air is necessary for each person per hour to dilute the carbon dioxide.

Tight Houses Save Fuel.

The prevention of unnecessary cold air leakage into the house not only saves heat, and, therefore, fuel, but decreases the dirt blown in.

In cold climates, on the side of the prevailing winds, storm sashes are effective.

Calking oakum or other calking material around window and door frames and weather stripping for doors and windows, whether of wood, rubber, felt or metal, when properly put on, are a good means of reducing unnecessary cold air leakage.

In many houses the space between the roof and the upper story is so open as to easily let cold air get in through the ceiling or heat radiate out.

Cellars are always desirable since floors where the wind can get underneath are not only uncomfortable but serious heat wasters.

In many of the recent houses, especially those "built to sell," the construction is so defective that a reasonably tight room cannot be secured. Fuel savings of 15% to 25% are easily possible by making the house tight.

Respiratory Diseases Increase During Heating Season.

About one-third of all of the deaths in this country are due to respiratory diseases. The death rate, collectively, of bronchitis,

tonsilitis, influenza and pneumonia is on the increase, and this with coryza (common colds) and catarrh are the most deadly forms of communicable diseases in the United States. In the last 50 years, practically all other forms of bacterially caused diseases have been brought under control while the respiratory diseases have increased. Pneumonia is one-third more frequent in urban than in rural districts.

The seasonal cycle of pneumonia, where house heating is necessary, is startling. Of the total annual deaths about 40% occur during the winter months, 24% during the fall and spring quarters and 10% during the summer. That is, the highest death rate occurs during the heating seasons. This is believed to be due to lowering of vitality on account of improper heating and ventilation. The toxic action from combustion products—especially carbon monoxide—from flue-less gas heating stoves is undoubtedly also important.[6]

Blower for Cold-air Inlet of Hot-air Furnace.

Most hot-air furnaces have a sluggish hot-air draft—depending on the wind—on some days or to some rooms of the house. Placing an electric motor fan in the cold-air intake will:

Make the draft positive and independent of atmospheric conditions. Increase the volume of air going through the furnace and delivering more heat but at a lower register temperature, that is, deliver a "warm" instead of a "hot" air, thus producing better living conditions in the room. Absorb more heat from the fuel, thus decreasing the fuel consumption.

Common Defects of House Heaters.

1. Crude construction. Draft dampers frequently leak so much air that the fire can be kept down in mild weather only by opening the heater door.

2. Inadequate heat insulation thus resulting in heating basement instead of the living room.

3. Insufficient heat absorbing surface resulting in the combustion products leaving at too high a temperature and the heat going up the chimney.

4. In hot-air furnaces, loose joints permitting ash dust and smoke to get into heated air. Where gas is burned in the or-

6 "American Journal of Public Health," December, 1922, page 1015, "Measures for the Control of the Acute Respiratory Diseases," and page 1022, "Plans to Reduce the High Mortality from the Acute Respiratory Diseases in Winter."

dinary furnace—with cement joints—the water vapor in the combustion products rapidly disintegrates the cement and causes the joints to open, and will permit combustion products leaking into the heated air.

5. No provision for adequate humidifying of heated air.

PART II.

ANTHRACITE.[7]

Size Prejudices.

The public has been erroneously taught to believe that only the so-called "domestic sizes" of anthracite could be used in the home.

The small "steam sizes" represent 29% of the total anthracite mined. As the public—through lack of understanding of the facts—has been unwilling to use these they become mere by-products and are sold below cost of production at whatever they will bring and used in competition with bituminous coal without regard to their intrinsic value. For instance, when the f. o. b. mine price on "stove size" was $8.10 the "steam size" brought as low as $1.50 per ton. The loss on the "steam sizes" must be made up on the "domestic sizes." Yet with proper utilization methods these steam sizes can be successfully used in the home.

Fewer Sizes Desirable.

Trade customs and improper utilization methods have resulted in an unnecessary number of sizes. These all add to the ultimate cost. From the public's viewpoint it would be very desirable to arrange for an immediate reclassification and the adaptation of domestic appliances to the use of the smaller sizes, that, under existing market conditions, are sold in competition with bituminous coal.

River Coal in Pennsylvania.

This is a very small sized anthracite that washes down the Susquehanna, Lehigh and Schuylkill rivers, from the mining districts above. Some of it comes from the washeries at the mines and some from old culm piles established as waste dumps many years ago. While much slate is found mixed with the coal when taken out near the mines, by the time the coal is dredged out of the river it is practically free of slate and bone.

7 Summarized, largely verbatim, from U. S. Bureau of Mines Technical Papers 97, 199 and 303; and American Society of Mechanical Engineers "Rules for Fuel Conservation in the Home."

Burning Small Anthracite in the Home.[8]

To burn any small anthracite, it is necessary to provide forced draft at the rate of about 235 cu. ft. of air per pound of coal burned. The size of motor required rarely exceeds 1/6 horsepower and requires about 8 kw. of electric energy per net ton of coal burned.

A cast iron plate—with about 10% of its area in holes—about ½ inch diameter—is laid on top of the old grate and cemented tight around the edges of the furnace so that all the draft must pass through the holes.

Fires are cleaned entirely by hooking clinkers out of the firing door. Only a very small amount of dust finds its way through the small holes in the plate into the ash pit, and it is rarely necessary to clean an ash pit more than twice during an entire season.

The stack damper must be entirely removed or fastened in its open position to prevent closing.

In firing and in banking, it is very important that at least one bright spot be left uncovered in order that the gases, as they are driven off the fuel bed, will be ignited.

In banking the fire, it is not necessary to stop the blower.

The system lends itself well to thermostat regulation; the thermostat being employed to stop and start the motor instead of opening and closing the dampers.

Summarized Rules for Burning Domestic Sizes Anthracite.

1. Carry a deep fuel bed—5 to 10 inches thick—so that it will not burn through in spots and admit a large excess of air.
2. Shake the grate to remove ashes, but stop before live coals appear in ashes.
3. Fresh fuel should be spread evenly over the entire grate area.
4. Be sure to leave one visible bright spot of live coal to ignite the gases coming off the freshly fired fuel. In this way the gases from the coal will be burned gradually and will not accumulate in the fire pot and burn with an explosion.

8 Selig & Wilson, engineers, Harrisburg, Pennsylvania, have directed the installation of river-coal burning equipment in a number of schools and demonstrated that the same amount of heating can be done with 15 per cent less tonnage of river coal than with freshly mined domestic sized anthracite. They also advise that there are over 2,000 homes in Harrisburg successfully using this coal and that they have found that small multi-vane type blowers directly connected to single phase, constant speed, repulsion-induction ball-bearing motors give the best service for house blowers.

5. After firing, keep the dampers wide open until blue flame appears, then check off the draft as much as necessary to keep fire burning at desired rate.

Rules for Burning Coke with Pea or Buckwheat Anthracite.

Follow 5 rules in preceding section and:

1. Spread a thin layer of anthracite over the entire grate and allow a few minutes for this fuel to ignite. Next fill the fire pot with coke and allow this to burn until blue flame appears then add another layer of anthracite.

2. When banking the fire use less coke and more anthracite, but otherwise fire in the same manner.

PART III.

BITUMINOUS COAL.[9]

Preferable Sizes.

The small sized coal—like nut—will be easier to handle and more economical than the large lump coal. Uniformity of size is desirable because it permits easier control of fire.

Wetting Coal.

The practice of wetting coal decreases the fuel economy, as heat from the fuel must be used for evaporating the moisture. With very fine coal, and particularly when the grates are not designed for fine fuel, it may become necessary to moisten the coal in order to reduce the loss of fuel through the grate.

Why Smoke is Formed.

If the entire surface of the fuel bed is covered with a heavy charge, the volatile matter from the fired coal does not ignite for a considerable length of time after firing and passes away as tarry, greenish-yellow smoke.

Smoke comes primarily from improper burning of bituminous coal. In most residential communities, the trouble is largely from house chimneys. Smoke prevention appliances—easily adapted to industrial plants—are not generally feasible in the home. Therefore, smokeless fuels should be used.

How Smoke May Be Reduced.

Instead of leveling the fuel bed and putting on fresh coal in an even layer over the entire fire box, the coked and partly burned coal remaining from the previous firing should be pushed

9 Summarized, largely verbatim, from U. S. Bureau of Mines Technical Papers 97, 137, 180, 199 and 303; Kansas State Agricultural College, Manhattan, Kansas, Bulletin 8; and University of Pittsburgh, Pennsylvania, Smoke Investigation Bulletins Nos. 1 to 8 and 10.

as much as possible to one side of the fire box and the fresh coal thrown into the empty side so as to have some of the burning coal exposed. In this way the green coal is heated slowly, the volatile gases are given off gradually, and are ignited by the adjacent burning coal instead of going to waste up the chimney unburned.

Summarized Rules for Burning Bituminous Coal.

1. Bituminous coal requires more draft and attention than anthracite or coke.
2. Ordinarily, shaking down the ashes will be required only once a day. Then shake only until the glow of the fire is seen in the ash pit, not until burning coals appear.
3. Pull clinkers out, do not try to work them through the grates.
4. A deep fuel bed is desirable.
5. Stir up the fire and get it hot before adding new fuel.
6. Use some coking method of firing, that is, work the partly burned coal, from which the gas has been driven, to one part of the fire and throw the fresh coal on the remaining portion.
7. Leave visible a bright spot of live coal to ignite the combustible gases coming off the freshly fired coal.
8. After the fuel is partly burned, more heat can be obtained by breaking up the fire bed with a poker if the fuel bed is caked.
9. In banking the fire, the drafts should be open for about half an hour so that the volatile matter in the coal can be driven off before the air supply is greatly reduced.
10. Keep flue surfaces free from soot and cleaning doors tightly closed.

PART IV.

COKE.[10]

What Coke Is.

Coke is the solid residue—carbon and ash—left when bituminous coal is heated without access of air. It burns with a smokeless flame and has aptly been called a "man-made anthracite" and can easily be used in existing appliances to replace anthracite.

Proper Quality and Size.

The coke must not be too hard. The best size is between one-

10 Summarized, largely verbatim, from U. S. Bureau of Mines Technical Papers 242, 303 and 315.

half and two inches. The screenings should be delivered with the coke because they are needed for banking fires.

Kindling a Coke Fire.

For starting a fire in an ordinary furnace or boiler in a 6 to 10 room residence, about 10 to 15 pounds of kindling wood is needed. When the wood is well ignited it should be covered with a layer of coke about 6 inches thick. It will usually take one hour to get this first layer of coke burning nicely. All the available draft should be used to start a fire; the stronger the draft the sooner the fire will start.

Proper Thickness of Coke Fuel Bed.

After the first layer of coke is well ignited the furnace should be filled to a depth of 14 to 18 inches. A thick fuel bed helps to check the draft and gives a slow uniform combustion and uniform temperature in the house. With a thick fuel bed the fire will last a long time without requiring attention. If a thin fuel bed is carried the coke burns too fast giving a hot uneven fire that burns out quickly and requires frequent firing. A thin fire also tends to produce more clinkers.

How to Regulate Draft.

To get good results from a coke fire the draft must be kept under control. The amount of draft required depends on the weather conditions and the size of the coke. Generally speaking, it takes much less draft to burn coke than it does to burn anthracite or bituminous coal. If too strong a draft is used after a fire is started, the coke will burn too fast making the house too hot and requiring frequent firing.

Shaking the Grate.

A coke fire requires less shaking of the grate than a coal fire. In ordinary weather one shaking a day, preferably in the morning, is all that will be necessary. Some people who have burned coke for many years say that they get better results if they have a layer of ashes about 1 to 2 inches thick on the grate all the time. The ashes help to check the draft and keep the hot coke from coming in contact with the grate.

Banking Coke Fire.

For banking the fire, the fines from the coke pile should be used. The fines make a denser fuel, reduce the draft through the fuel bed, and thus help in keeping the fire. The fuel bed may be made still denser by lightly tapping the coke on the top with a poker or shovel. The ash pit door should be closed as

tightly as possible and the draft in the furnace reduced by opening the check damper. If the ash pit door does not fit tightly, in order to keep the fire over night, it may be necessary to open the damper in the firing door.

Starting Coke Fire After Banking.

If a good bed of hot coke about 6 inches thick is on the grate, the grate may be shaken, clinkers removed, the fire leveled, and a heavy charge of coke placed in the furnace. Opening the damper in the ash pit and closing the check damper in the smoke pipe will help to start the fire quickly. After about half an hour when the freshly fired coke has been well ignited, the damper in the ash pit door can be nearly closed and the check damper partly opened.

If the fire is almost burned out do not shake the grate or remove the clinkers, but level the fire with a poker, slightly stirring it so as to shake some of the ashes down and then fire about a 6-inch layer of coke.

Summarized Rules for Burning Coke.

1. Carry a deep bed of fuel; a bed about 18 inches thick gives best results.
2. Use very little draft after the fire is started and keep it always under control.
3. Do not stir the fuel; clean the fire in the morning, if possible.
4. Use sized coke; one-half to two inches for furnaces, boilers and stoves; one-half to four inches for open grates.
5. Do not allow ashes to accumulate in ash pit.

PART V.

MANUFACTURED GAS AND NATURAL GAS.[11]

Manufactured Gas and Natural Gas Compared.

Manufactured gas is man-made by "transmutation of crude, dirty inert coal into energetic gas." Natural gas is made by nature and is transmitted to the consumer in its natural state.

The heating value of natural gas is about twice that of manufactured gas. That is, it takes 2 cu. ft. of manufactured gas to furnish the heating energy of one cu. ft. of natural gas. Because of its higher heating value, natural gas requires twice as

11 Summarized, largely verbatim, from Smithsonian Institution Bulletin 102, Part 8; Ohio State University, Columbus, Ohio, Bulletin 28; and U. S. Bureau of Mines Technical Papers 257 and 325.

much air for combustion as is required by manufactured gas, otherwise the two gases are handled just the same in the home appliance.[12]

Natural gas does not have a distinctive offensive odor like manufactured gas and this makes the detection of natural gas leaks in the home more difficult.

The flame temperature of the two gases are substantially the same.

Correct Use of Luminous-Flame Burners.

Large volumes of gas, to be burned, must have some of the air mixed with the gas before the gas reaches the flame. Air is sucked into the mixing chamber of the gas burner by the aspirating action of the gas. The air shutter must be adjusted until a clean blue flame is produced. A yellow flame with this type of burner is an indication of waste.

Correct Use of Luminous-Flame Burners.

Small volumes of gas forced out through a small hole, about the diameter of a pin, can get enough air to insure perfect combustion with a yellow flame. This can be used only for room-heating purposes and then only in positions where the flames do not impinge on each other or on any surface.

Correct Position of Cooking Vessel.

Grid or open-top stoves are desirable for good service, so as to get the most direct path for the heat from the flame into the food.

Many natural gas cook stoves have solid tops and burners 2½ to 3½ inches away. This is wrong. Such stoves always waste gas and frequently will not give any service when the pressure is low, whereas, good service can be secured under low pressure conditions when the tip of the flame just touches the cooking vessel.

Natural Gas Pressures Frequently Too High.

Natural gas appliances should always be adjusted for low pressure only, and only low pressures—1 to 2 ounces—used. This would save gas and give better service during the inevitable low pressure conditions when the demand is greater than the available supply.

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12 Of the total volume of gas sold annually in the United States for public utility service 560 billion cu. ft. is natural gas and 326 billion cu. ft. is manufactured gas.

Flues Always Desirable on Room Heaters and Water Heaters.

Even with perfect combustion, it is not desirable to have the carbon dioxide and water vapor—that always must be formed—remain in the room.

If the burners are not correctly adjusted or, even with correct adjustment, if something goes wrong so that the heater begins to generate carbon monoxide gas—which is a poison—the use of adequate flues is a good insurance against accident.

Candle Power Standards Are Obsolete.

Gas lighting should be from incandescent mantle lamps only. It is squarely against the public's interest for any community to maintain a candle power standard for manufactured gas so as to permit of the use of open flame burners.[13]

Proper Adjustment of Incandescent Lamps.

The lamp must be closely adjusted if efficient and satisfactory results are to be obtained. Hissing or roaring sounds are indicative of excessive or bad adjustment. Adjust the lamp by adjusting the air shutter and gas needle valve of the burner so as to obtain a maximum illumination and quietly burning lamp.

Summarized Rules for Correct Gas Use.

1. Blue (Bunsen) flame burners must be properly adjusted and burn blue only.
2. The inner cone of the blue flame must not strike any surface.
3. Solid tops on cook stoves should not be used; use grid or open tops only.
4. Top burners on cook stoves should be only 1¼ inches below vessel, and gas used at low pressure only.
5. Radiants in radiant fire heaters should never be operated so the radiants glow more than ¾ of the distance from bottom to top.
6. The flames on "luminous-flame" heaters must not strike each other or any surface.
7. Incandescent mantle lamps must not hiss or roar.
8. Flues should be used on all water heaters and room heaters used continuously.

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13 For further discussion see Technologic Paper 222, "Relative Usefulness of Gases of Different Heating Value and Adjustment of Burners for Changes in Heating Value and Specific Gravity," U. S. Bureau of Standards, Washington, D. C.

9. Never use gas in any coal-burning appliance, it will always be wasteful.

10. Water heaters should have enough heat-absorbing surface to get the heat into the water and have the gas combustion products cool where they leave the heater.

PART VI.

FUEL OIL.[14]

Kinds of Oil Burners.

The mechanism for burning oil may be divided into two general classes:

A. Wick burners: These work on the same principle as the ordinary kerosene lamp. The wick by capillary attraction raises the oil through the wick from the reservoir below to the wick top where it is burned. These are feasible only for cook stoves, hot water heaters and small room heaters.

B. Atomizing or vapor burners: In these the oil is changed in form, it is broken up or atomized or converted into vapor by pressure or heat or both pressure and heat. The pressure for atomizing may be secured through the medium of a hand pump similar to an automobile tire pump or through an electric motor-driven mechanism; the heat for starting the burner from alcohol or gas. The various oil burners on the market vary so largely in construction and operating details that general instructions for proper adjustment cannot be given.

Oil Must Be Clean.

The container for shipping the fuel oil—wooden barrel or steel drum—frequently permits small particles of dirt to get into the oil. All oil burners somewhere in their construction have small openings through which the oil must pass. Dirt in the oil causes these to clog, therefore, the oil before it goes into the storage tank in the home should be carefully strained.

Misleading Claims About "Burning Air."

Many claims have been made alleging that certain burners "burn such and such an amount of air" and the statements are so worded that the public gets the impression that this air for burning is something peculiar or unique with oil burners and,

14 For discussion of oil burners for water heaters see Kansas State Agricultural College, Manhattan, Kansas, Bulletin 6. For data on cost of oil for cooking see Bulletin on "Relative Cost of Gas, Soft Coal, Coal Oil, Gasoline and Electricity for Cookng," Department of Home Economics, Ohio State University, Columbus, Ohio.

therefore, since nothing in the world is so cheap as air, that the particular burner will give unusually cheap fuel service, Whereas, all fuels—see §1—require air for burning and this is not a peculiar feature of oil at all. Such misleading statements, of course, ultimately must lead to a reaction against oil burner installations.

Using Oil in Coal-Burning Appliances Is Wrong.

The only way that the best results can be obtained in using oil for either cooking or house heating is to burn the oil in appliances either special built for oil or for gas. This is because the ordinary coal-burning appliance does not have enough heat-absorbing surface to get the heat produced into the room and, as a result, the burning of oil in coal appliances will always be wasteful.

Field for Oil Use in the Home.

When gas is not available, oil is much more desirable than any solid fuel for cooking and hot-water heating. For house heating, in properly constructed furnaces, oil is desirable and, if properly handled, because of ease in controlling, can be made to give satisfactory service.

The present—September, 1923—over-production in oil, in the light of past experiences, is merely temporary and fuel oil prices may be reasonably expected to be materially increased again after the oil industry goes back on a normal basis.

Prize Contest open to all High School Students for Posters on Health Subjects

HYGEIA, a magazine of health, published by the American Medical Association, offers a series of 49 prizes for posters on any health subject submitted before May 31, 1924. The Jury of Award will be: Surgeon-General Hugh S. Cumming, U. S. Public Health Service; Mr. John T. McCutcheon, cartoon artist for the Chicago Tribune; President William B. Owen, Chicago Normal College, Ex-President of the National Education Association. Full information concerning this contest, list of prizes, rules of the contest, etc., can be obtained by writing to the Poster Editor of HYGEIA, care of American Medical Association, 535 North Dearborn St., Chicago, Illinois.

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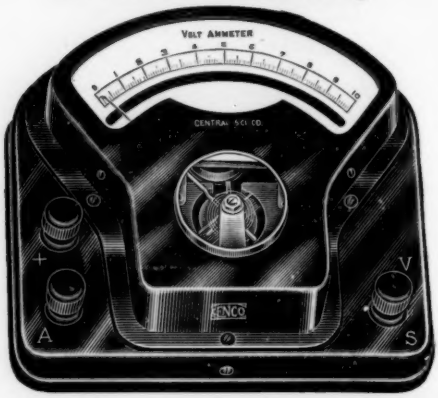

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